M. Ujfalvy for the first time. Apparently these authors have gathered their ideas from the French writers of the last century, whose knowledge of Chinese was confined to such works as the *B'ungkien Kangmu*, or even later works of about as much authority as Rollin's "Universal History."

A good deal of interest attaches to the Yueh-ti. Their original name was possibly Viddhal, and they seem to have had some prehistoric connection with the Yâdavas, who took part in the Indian immigration. There never was any doubt about their being the same people afterwards known to Greeks and Arabs as Ephthalitæ and Haithals respectively. With the Yueh-ti were associated in ancient Chinese legend the Mats, or Mat-su, apparently Maddhals, as in Indian lore Maddhu is associated with the Yâdavas, and this brings us to the later branch of the Yueh-ti, who in these authors by a strange mistake are called Yetha. Really the name in modern Chinese is Yenta, a very different sound. In the old language it was I'm-dat. Where the first syllable appears frequently doing duty as merely the initial *m*, Da, or rather Dat, where final *t* represents *l*, stands then for Maddhal. This subtribe seems about the fifth century to have been settled in the neighbourhood of Bamian, and, except that it was less civilised than the other branches of the family, to have had little to distinguish it.

Both Greek and Chinese authors concur in describing these Ephthalites as being distinctly blond, with full beards, of a handsome type, and of lively manners. Menander calls the king under whose guidance they crossed the Hindukush Catulphus, at whose Teutonic aspect Colonel Yule expresses surprise. The Chinese, however, name him Kitolo, evidently the same word; most Chinese names consisting of only three words, the remainder is generally omitted in the transliteration of foreign names. Catulphus is, however, evidently the nearest Greek equivalent for Gothic Caedwulf. These allied peoples went amongst the Indians by the common appellation of Hunas, whence the alternative Greek name of White Huns, which has no connection whatever with that of the European Huns of the fourth century, whose swarthy complexions and hairless faces indicate a very different origin. These apparent Gothic connections are not confined to the Ephthalites, but occur throughout, the leader of the Scythians, ἐκ τῆς Ἀσίας, *i.e.* Wusuns, whom Alexander defeated outside Kyropolis, was, according to Arrian Satrakes, the Greek equivalent for Gothic Sietrich.

Of Dr. Haddon's Hoa, evidently derived from some mistaken French transliteration, I cannot even guess the origin. There is no such name to be found in the earlier and more authentic Chinese writers. Dr. Haddon is, however, quite correct in identifying the modern Chinese Yuan yoan, or Jwan Jwan, with the Avars of Gibbon.

Dr. Haddon expresses some surprise at the beardless faces of the later Huna kings; from the appearance of the king depicted on the coin, and its overhanging brows and prominent nose, he certainly did not belong to the smooth-faced races of the extreme north and east of Asia. So we may be sure that the bareness was artificial; it was probably the fashion of the time to shave.

With regard to the type of face and skull represented on the coin of Jayatu Mihirakula, I may remark that I met last night at dinner a gentleman of whom it might be called a portrait. I may describe him almost in Dr. Haddon's words as: Nose large, jaw powerful, neck fleshy, the occipital region of the head deficient, the vertex produced into a truncated cone. This remarkable shape was in his case quite natural. Moreover, with the exception of a moustache his face, as in the coin, was hairless. He had similar overhanging eyebrows, a like marked notch at the bridge of the nose, and an almost identically aquiline nose. His eyes, however, were not oblique, nor had he the slightest trace of the "Tatar," nor did he in any way approach the "Mongolian" type. The gentleman is, in fact, a Parsee of the highest type, polished and affable.

Shanghai, China, March 13. THOS. W. KINGSMILL.

Graphic Solution of the Cubics.

THE note by Mr. T. Hayashi, published in NATURE of March 28, suggests to me the following little historical remark. The method given by Mr. Hayashi for the cubics is due to Monge, "Correspondance sur l'École impériale polytechnique," par M. Hachette, vol. iii. p. 201; "Solution graphique de l'équation du troisième degré, $x^3 - px + q = o$," par M. Monge.

"L'équation proposée résulte de l'élimination de y entre les deux $y = x^3$, $y = fx + q$; l'une est le parabole cubique, . . . l'autre répresente une droite. . . . Ayant construit ces deux lignes, les abscisses x des points où elles se coupent, sont evidemment les racines de l'équation proposée."

Monge gives also a practical construction of the curve on a small sheet of paper *Nil sub sole novi!* G. VACCA.

Via Bogino, 4, Torino (Italy).

THE WORK OF THE NATIONAL ANTARCTIC EXPEDITION.

THE final programme of the scientific work of the National Antarctic Expedition had not been arranged at the date of my departure from England, as the Joint Committee of the Royal Society and the Royal Geographical Society had not issued its full instructions as to the route and plan to be adopted. A provisional summary may, however, be useful by calling forth suggestions while there is yet time to use them.

FIELD OF OPERATIONS.

It is, perhaps, hardly necessary to remark that it is not the object of the expedition to reach the South Pole, but to investigate the Antarctic regions; and though some of the problems cannot be solved unless the existing southern record is broken, the expedition is not being equipped especially for the attainment of much higher latitudes than have already been reached. Had that been one of the main objects of the expedition, either the ship might have been sent southward on a different line, or the expedition would have been provided with greater sledge-hauling power.

The operations of the British expedition are restricted to the half of the Antarctic area east of the meridians of 90° E. and 90° W., *i.e.* to the region south of Australia and the Pacific. The western half, including the region south of America, the Atlantic and Africa, is to be explored simultaneously by the German expedition under Prof. von Drygalski, by a Swedish expedition under Dr. O. Nordenskjold, and, it is hoped, also by a Scotch expedition under Mr. W. S. Bruce. This division of the field of work between the British and German expeditions was proposed at the Geographical Congress at Berlin, and has now been accepted on both sides and the plan of work arranged accordingly. So far as can be judged with our present knowledge, this plan, other things being equal, gives the German expedition the chance of the most striking geographical discoveries and the British expedition the opportunities for a richer harvest of scientific results.

The scientific work of the expedition is directed to cover as wide a field of research as is consistent with the essential objects of the expedition. Of these the object of primary importance is the study of terrestrial magnetism. It was upon the need for work upon this subject that the appeal to the Treasury for funds was based, and it was to enable the magnetic observations to be properly made that it was thought advisable to provide a new ship rather than adopt the less expensive course of adapting an existing whaler. A new ship—the *Discovery*—has accordingly been built by the Dundee Shipbuilding Co. She is a modified whaler of somewhat more than 1500 tons displacement, and with engines of 450 horse power.

The staff of the expedition is as follows:—The executive staff consists of Commander R. F. Scott, R.N., commander of the expedition; Lieutenant Albert Armitage, R.N.R., who distinguished himself in the Jackson-Harmsworth expedition to Franz-Josef Land, second in command and navigator; Lieutenants Royds, Barne and Shackleton; and Mr. Skelton, engineer. The civilian staff consists of Mr. T. V. Hodgson, formerly of the Plymouth Biological Laboratory and curator of the Plymouth Museum, biologist; Dr. R. Koettlitz, botanist; Mr.

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Wm. Shackleton, of the Solar Physics Laboratory, physicist and astronomer; Dr. E. A. Wilson, zoologist and doctor to the land party; and the writer, who is director of the civilian staff and in command of the operations on shore. It is hoped that it may be possible to arrange for additional scientific assistance from volunteers who will accompany the ship in her cruises from Melbourne. Mr. G. Murray, F.R.S., who is editing the "Antarctic Manual," has kindly consented to act as deputy director of the civilian staff, and will superintend the scientific equipment in England, and probably accompany the *Discovery* as far as Melbourne.

TERRESTRIAL MAGNETISM.

Considerations for the magnetic work have exercised a dominant influence in the plan of operations ordered by the Joint Committee. Magnetic work in the British field of operations has difficulties from which work in the western half of the Antarctic area is free; the horizontal magnetic force is exceptionally low, and great decimal variations in declination are frequent. These variations will, of course, affect the observations made on the *Discovery*, and unless this factor can be allowed for, it will be impossible to determine the proper magnetic elements for the ship's points of observation. Accordingly, the Magnetic Committee has declared it essential that there should be a station on shore in Southern Victoria Land to act as secondary magnetic base. It will be the first duty of the party landed at this station to secure a continuous magnetic record for a period of twelve months. For that purpose it will be supplied with a magnetograph, which will be under the special care of Mr. Shackleton; should the recording instrument fail, personal observations must be taken as frequently as possible. The records at this station will enable the observations taken during the magnetic survey at sea to be corrected for diurnal changes.

The Joint Committee has, therefore, decided that the *Discovery* shall proceed from her southern headquarters at Melbourne to Southern Victoria Land, where Captain Scott will land a party somewhere between McMurdo Bay and Wood Bay. The land party will consist of eight men, including Mr. Shackleton as physicist and Dr. E. A. Wilson as doctor and zoologist.

THE GEOGRAPHICAL PROBLEMS.

The selection of Southern Victoria Land, and the neighbourhood of Mounts Erebus and Terror, for the site of the land station is recommended by geographical as well as by magnetic considerations. Topographical exploration is the second important branch of the work of the expedition, for it is necessary as a base for much of the other work; and it was probably interest in this subject that inspired Colonel Longstaff's munificent donation, which brought the expedition within the range of practical politics.

Fortunately, sufficient is now known of the geography of the eastern half of the Antarctic area to enable a definite plan of operations to be arranged. We need not, like Cook, strike blindly into the Antarctic, knowing no more of one line than of another. There are two main geographical problems in the British field of work. The first problem is whether the known lands to the south of Australia—Victoria Land, Wilkes Land, Adelie Land, Geikie Land, Newnes Land, Termination Land, &c.—are all part of one great continent or are members of an Antarctic archipelago. The classical and mediæval geographers accepted the existence of an Antarctic continent, belief in which is now supported by Suess's principles of geographical distribution.

Australia, as Suess has explained to us, consists of a great plateau bounded to the north and east by the important tectonic line which passes through New Guinea, New Caledonia and New Zealand. Ritter has therefore very plausibly suggested that the volcanic chain that forms the eastern face of Victoria Land is the continuation of the New Zealand volcanic line, and that the coast of Wilkes Land is a southern extension of the Australian plateau.

This hypothesis, advanced at first on general considerations, is consistent with all available geological evidence. The specimens collected by Wilkes and the boulders dredged by the *Challenger* and the *Valdivia* include archæan and sedimentary rocks similar to those of Southern Australia; and Mr. Borchgrevink has brought home a collection of specimens which have been kindly shown to me by Mr. Prior, and are practically identical with some of the Lower Palæozoic rocks of Victoria.

The rocks of the eastern face of Victoria Land have been described by Teall and David; and their identifications show that the volcanic rocks resemble those of New Zealand.[1]

There is, therefore, little doubt that Antarctica is *geologically* a continent, consisting of a western plateau, composed of archæan and sedimentary rocks like those of Australia, and of an eastern volcanic chain. But whether Antarctica is still a continent *geographically* is less certain; and this question can only be conclusively settled by a survey. Land journeys westward and southward from Mount Erebus ought to settle this problem.

The volcanic line of Victoria Land runs north and south for some 8 or 10 degrees of latitude; at 77° S. lat. the coast and the volcanic chain bends abruptly to the east. The discovery of their eastward continuation is the second main geographical problem to be settled in the British half of the Antarctic area.

Ross sailed to the east for some 30 degrees, along the face of the "Ice-Barrier"; and though the origin of the barrier-ice is not yet certainly known, it has probably been formed on land. Ross has recorded a "strong appearance of land" beyond the eastern end of the barrier (160° W.), and the barrier may be roughly parallel to the edge of a land line connecting the Parry Mountains and Ross's "apparent land."

Beyond this point is a gap until, 70° further to the east, we come to Graham's Land. In the intermediate area there has been no direct record of any large land area that would connect Graham's Land and Victoria Land. But Cook's description of his view from his turning-point at 137° W. 67° S. is suggestive of a land with peaks rising through an ice-sheet rather than of a number of icebergs frozen into pack-ice. Cook, however, clearly interpreted it as the latter. The indirect evidence as to the geographical character of the line between Graham's Land and Mounts Erebus and Terror is more important. It is based on Suess's law of coast distribution.

The Pacific Ocean is bounded by coasts the trend of which is determined by mountain ranges which run parallel to the shore. This rule holds in Eastern Australia, Eastern Asia, Malaysia, and throughout the western coast of America with an unimportant exception in Central America. The remaining coasts of the world are on the Atlantic type, in which the coast lines are not determined by the trend of long, folded mountain chains; the mountain ranges are cut transversely or obliquely, and the coasts are mainly formed of plateaux and coast plains. Ritter has made the probable suggestion that the low coast of Wilkes Land is on the Atlantic type, and the high mountain chain of Victoria Land is on the Pacific type. Graham's Land has a characteristic Pacific coast; and when we remember the persistence of that type round the whole of the

[1] The continuation of the tectonic line that crosses Southern New Zealand obliquely to the main New Zealand line has not yet been determined, and it may be found to play an important part in the southern shore of the Pacific.

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known shores of the Pacific, it appears not improbable that the Southern Pacific is bounded by a coast of the same type. If so, we should expect the Parry Mountains and Graham's Land to be connected by a series of mountain bows, the curves convex to the north, and with at least the traces of island festoons.

In that case the great tectonic lines which bound the Pacific to east and west are connected across the Antarctic area; and if that can be proved the unity of the great Pacific depression will be completely established.

That this South Pacific coast line can be discovered and surveyed by the expedition is improbable; when we remember the limited extent of the areas explored by Arctic expeditions, one ship cannot be expected to investigate half the Antarctic zone in the course of sixteen or eighteen months.

Considerable indirect evidence bearing on this problem may, however, be obtained; information as to the geology of Dougherty Island, and an extensive collection of bottom deposits along the edge of the ice-pack in the Southern Pacific, would no doubt throw much light on the geographical character of the area to the south. The expedition, moreover, should secure information as to the oceanic circulation and ice-drift which will enable a carefully-thought-out attack on this quadrant to be made. Our knowledge of the Ross quadrant, as Sir Clements Markham has called it, is so limited that it gives us no trustworthy suggestion as to the best lines of entry. And the Joint Committee appears to have accepted the principle that the expedition should work where present knowledge gives most guidance as to profitable lines of discovery and research.

GEODETIC WORK.

The principal geodetic work of the expedition will be the continuation of the line of gravity determinations that has now been carried from California across the Pacific to Sydney, and thence through Melbourne, Tasmania and New Zealand. This work will be done by a new set of three of the Ellery half-seconds pendulums, which, thanks to Mr. Baracchi, have been made for loan to the expedition by the Victorian Government. The pendulum results will be checked by the use of two of the gravity torsion balances designed by Profs. Threlfall and Pollock.

If it be possible to land for a couple of days at Cape Adare, gravity determinations should be made there as well as at the land station in Southern Victoria Land.

SEISMOLOGY.

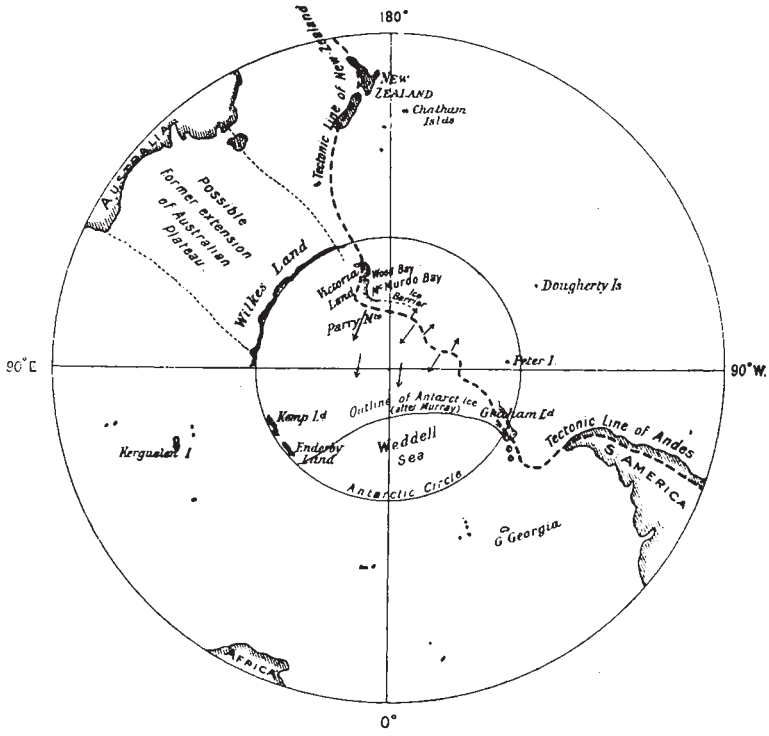
At this station a seismographic observatory will also be established. A Milne seismometer of the British Association pattern and a Ewing's duplex recorder are both to be installed.

METEOROLOGY.

A station on shore that will give a complete year's observations is necessary for the meteorological work as well as for the magnetic. The meteorological equipment will be exceptionally complete, thanks to the Admiralty, the Meteorological Council, Dr. R. H. Scott, Dr. H. R. Mill and Mr. W. N. Shaw. Recording instruments, including barographs, thermographs and hygrographs, will be established and checked by four-hourly direct observations; in case of the collapse of the recording instruments, observations will be taken every two hours, and during part of the year it will probably be possible to take them every hour.

As the observatory will probably be near the face of a lofty mountain range, the atmospheric conditions may be abnormal. To ascertain the conditions of the free air, it is proposed to fly kites with meteorographs. The Hargreaves kites, as modified at Dr. Rotch's observatory at Blue Hill, will be used.

The special meteorological problem to be determined by the combined expeditions is the existence of the hypothetical anticyclone over the South Pole. The careful meteorological observations made by Mr. Bernacchi during the Borchgrevink expedition have given almost a complete year's record for Cape Adare; they have shown the prevalence there of south-easterly winds which were unexpectedly warm, and are apparently due to a northern air-current being forced to sea-level and to return northward in the area to the south-east of Cape Adare.



Sketch map of Antarctic area, showing probable connection of the tectonic lines of New Zealand and the Andes through Victoria and Graham Lands. The arrows indicate probable directions of ice movement. The upper half of the map includes the British field of work; the lower half is that assigned to the German expedition.

OCEANOGRAPHY.

The expedition is also being generously equipped for oceanographic work, as the Admiralty, thanks to Sir William Wharton, is supplying the whole of the material. The first branch of this work will be the continuation of the contributions of former expeditions to the contour of the Antarctic ocean floor; and it is hoped that, in addition to complete series of soundings in special areas, new lines of soundings will cover a wide area around the edge of the ice-pack. The study of the bottom deposits collected during the soundings will be of especial interest, as bearing on the range and structure of the Antarctic lands; and their evidence will be supplemented by dredging for boulders with a special bucket-dredge.

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The determination of the oceanic circulation as shown by the varying temperature, salinity, specific gravity and refractive index of the sea water will be the most arduous part of the oceanographic work. Owing to the importance and difficulty of this research, independent methods will be used concurrently. In the aërial temperature determinations we hope, like the German expedition, to have the assistance of a platinum thermometer, arrangements for which are being made by Prof. Ayrton. The mechanical difficulties in the management of the cable renders it indispensable that a full equipment of mercurial thermometers shall be carried; but electric thermometry has reached a stage at which we may hope that in determining temperatures under the great pressures of oceanic depths we need not rely on a method dependent on volume.

The tidal work will be done at the shore station, where a tide pole will be erected and observations taken for at least three months. Tidal observations on the Antarctic shores, according to Prof. G. H. Darwin, "would be of especially great interest, since this is the only region of the earth in which the water is uninterrupted by land."

BIOLOGY.

The biological work of the expedition will be mainly at sea; for the ancient maxim that "Nature loves life" does not appear to apply to the Antarctic lands. The main biological duty of the expedition is to make as extensive a collection of the fauna and flora of the Antarctic Ocean as the ship's storage will admit. As the German expedition proposes to limit its dredging to work of less than a thousand fathoms, it is all the more advisable that the *Discovery* shall dredge in the deep basins as well as in the shallower seas; for though the latter may be richer in individuals, they will probably be comparatively poor in species; whereas the deeper parts of the Antarctic will probably be rich in novelties, and will afford the most valuable materials for the solution of the problem of bipolarity.

Sir John Murray's suggestive views as to the relations of the Arctic and Antarctic faunas are too well known to need re-statement here. His theory is based in the main on the *Challenger* collections, and much further material is required before it can be settled whether the resemblances between the Arctic and Antarctic faunas are homoplastic or homogenetic.

In the zoological work Mr. Hodgson will devote his attention mainly to the invertebrates, and Dr. Wilson to the vertebrates. Mr. Koettlitz will be the botanist of the expedition, and will study especially the phyto-plankton and bacteria of the Antarctic seas.

GEOLOGY.

The Antarctic continent being often described as buried completely under a pall of ice and snow is not regarded as a hopeful field for geological work. But though the conditions may be unfavourable, the geological problems of the Antarctic are exceptionally interesting.

Stratigraphically we may expect Wilkes Land to show us a continuation of the rocks of the Australian plateau; and as part of the South Australian coast is at least of Lower Cainozoic age, we may hope for marine deposits of the same age on the northern face of the Antarctic lands. That Palæozoic sediments and limestones occur there is now certain, and they ought to yield fossils if the right zones are exposed. Palæozoic fossils will be of value, but the discovery of Cainozoic land fossils would be of far wider interest. The Biological Committee has called attention to the importance of geological work on the Antarctic lands, and that alone can settle the problems of zoological distribution in South America, South Africa and Australia during Cainozoic times.

It is, however, the way with fossils to occur in soft beds which have been worn into hollows and buried in a country that has been roughly used by the elements. Hence the palæontological results may be meagre, and the palæontological and physical branches of geology will probably gain most from a preliminary traverse.

The glacial work, including the character and distribution of the different ice-agents, the relations of the valley glaciers to the main ice-sheets, the physics of glacier ice, and especially the relation of shearing planes to the orientation of the ice-grains; the distribution of morainic and intraglacial material and the rate of flow of the glaciers are all problems which it is recommended that the members of the expedition should study. Prof. von Drygalski's work in Greenland has called renewed attention to the theory that glacial flow is due to repeated melting and regelation; whereas Müggé's experiments on the shearing planes in ice support the view that plasticity is an essential property of ice. Further experiments on this question will be conducted during the winter on blocks of glacier ice.

The nature of the inland ice is a problem that can only be directly solved by sledge journeys; and if sufficient dog transport be provided, it is hoped that two sledge parties will start from the land station in the early spring. One party will naturally strike westward to cross the mountain range, and the other to the south. How far these parties may be expected to penetrate into the interior will depend on the amount of sledge-hauling power available and on the structure of the country. The westward party would, it is hoped, cross the volcanic mountain chain to the plateau that probably lies beyond it. If the station be established at McMurdo Bay, the southern party ought also to penetrate beyond the coast ranges and discover what lies between the Parry Mountains and the South Pole. On the hypothesis that the South Pacific coast is on the Pacific type of coast structure, then we may expect that the greatest elevations on the Antarctic Lands will lie along the Graham's Land-Victoria Land line, and will be near the sea. To the south of the main mountain range there may be an undulating ice-covered region descending slowly across the Pole to the shore of the Weddell Sea. The main ice-drainages would then be not from the Pole radially in all directions; the ice-shed would run along the Pacific shore with a short steep northern face and a long gradual slope southward to the Pole and across it northward to the Atlantic. That the main ice discharge from the Antarctic lands is into the Weddell Sea is probable, since the biggest of the Antarctic icebergs, including those described as sixty miles long and forty miles broad, are apparently discharged from the Weddell Sea. As these bergs are discharged intermittently, it has been suggested from earthquake action, the Weddell Sea route to the south probably varies greatly in different years, and success in penetrating to the coast-line there might yield comparatively barren results, for the ship would probably be stopped against the stranded border of a vast ice-sheet, and find neither land for a shore station nor harbour for a ship; and travel over the ice-sheet would be unprofitable. As Sir Clements Markham has expressed it, "the Weddell route offers the minimum of results with the maximum of risks."

The Erebus and Terror region, on the other hand, offers a known base of operations, for a landing has already been effected on its shore. And the available geographical, geological and meteorological data all point to it, as in the critical part of the Antarctic lands.

J. W. GREGORY.

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